



Research Article/Özgün Araştırma

The effect of aerobic and anaerobic exercise on biochemical parameters in adolescent male athletes

Adolesan erkek sporcularda aerobik ve anaerobik egzersizin biyokimyasal parametreler üzerine etkisi

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Abstract

Aim: The aim of the present study is to determine the effect of basketball training on the creatinine, urea, and electrolyte balance of basketball players.

Materials and Methods: The present was conducted by a total of 34 healthy young boys. Participants were randomly divided into 2 groups to be the control group ($n=17$) and the training group ($n=17$). The training groups underwent two hours of basketball training for five days a week in a span of eight weeks.

Results: As the results of the present study, urea, creatinine, and plasma mineral levels increased statistically significant. Creatinine, urea, and blood urea nitrogen were significantly affected by the training ($p<0.005$). Sodium, potassium, phosphorus, chlorine ($p<0.05$), magnesium, calcium and iron ($p<0.005$) levels were also significantly affected by the training.

Conclusion: The regular exercise training increased the levels of urea, creatinine and plasma minerals by affecting the creatinine, urea and electrolyte balance of basketball players.

Keywords: Exercise; Urea; Creatinine; Electrolyte; Training.

Öz

Amaç: Bu çalışmanın amacı, sekiz haftalık basketbol antrenmanının basketbolcularda kreatinin, üre ve elektrolit dengesine etkisini belirlemektir.

Gereç ve Yöntem: Mevcut çalışmaya, 34 sağlıklı genç erkek çocuk dâhil edildi. Katılımcılar rastgele bir kontrol grubuna ($n=17$) ve bir egzersiz grubuna ($n=17$) ayrıldı. Egzersiz grubuna sekiz hafta süre ile haftada beş gün iki saat basketbol eğitimi verildi.

Bulgular: Çalışmada üre, kreatinin ve plazma mineral seviyeleri istatistiksel olarak anlamlı artış gösterdi. Egzersiz grubunda kreatinin, üre ve kan üre nitrojeni değerleri ($p<0,005$) ile sodyum, potasyum, fosfor, klor ($p<0,005$), magnezyum, kalsiyum ve demir ($p<0,05$) seviyeleri de önemli ölçüde etkilendi.

Sonuç: Düzenli egzersiz eğitimi, basketbolcuların kreatinin, üre ve elektrolit dengesini etkileyerek üre, kreatinin ve plazma mineral seviyelerini artırmıştır.

Anahtar Kelimeler: Egzersiz; Üre; Kreatinin; Elektrolit; Antrenman.

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Introduction

Regular exercise improves the renal function, strength and physical function, and health-related quality of life. Urea and creatinine are nitrogen-containing end products.¹ Serum creatinine and urea measurement are the most commonly used indicators of renal functions.²

Creatinine is produced by the liver and taken exogenously. Creatinine is associated with the skeletal muscles.^{3,4} After doing exercise, plasma creatinine significantly increased with 18–25 hours of rest after a run.^{2,5,6} Thereafter, increased plasma creatinine returned to normal values. Moreover, creatinine is one of the most widely used supplements for athletic performance improvement.⁷

Blood urea level (BUN) changes in sports groups vary depending on pace, type, and time of the exercise, as well as climatic conditions, gender, and individual factors.⁸ Although creatinine concentration returned to its resting value 18–25 h after a run, the plasma urea level remained high.⁶ Urea levels significantly increased in a 2–4 weeks training period.⁹

Electrolyte balance is critical to the function of all organs and maintaining health.¹⁰ Loss of fluid, loss of body mass, and dehydration cause a decrease in plasma volume.^{8,11,12} This agent has an important role in the decrease of sodium, chlorine, and total salt (NaCl).¹³ Sweating is an important part of potassium reduction.^{13,14} Therefore, a lot of work is done on over the concentration of sodium and chlorine during sweating and supporting the body.^{10, 11, 15-17}

Basketball is a sport characterized by intermittent bouts of high-intensity exercises. Kidney function and electrolyte levels create compliance during intense exercises. Therefore, the purpose of the present study is to determine the effect of an eight-week basketball training on the creatinine, urea, and electrolyte balance of basketball players.

Materials and Methods

Participants

The present study was conducted on a total of 34 healthy young boys. The age range is between 13 and 16. Participants were haphazardly divided into 2 groups. The first of these groups is the control group ($n=17$) and the second is the training group ($n=17$). Groups were categorized as "pre" and "post" (ie, pre-control and post-control groups, pre-training and post-training groups).

Training procedure

Training groups are basketball players who have played basketball for at least two years and participated in the pre-season preparation program two months after the break. The training groups underwent two hours of basketball training for five days a week in a span of eight weeks. Before the exercise training started playing 80 minutes of basketball, they did 30 minutes of warm-up and 10 minutes of stretching. The control group consisted of haphazardly selected young men who did not exercise continuously but had same eating habits with the training group. This training procedure was also used in our previous study.¹⁸

Ethical approval

Before starting this study was approved by our university's Non-Interventional Clinical Research Ethics Committee (Decision No: 2017/7-1). All the test procedures were performed after ethics committee approval according to the Helsinki Declaration of Principles and corporate ethical standards. A written informed consent was obtained from the participants and their parents before the study.

Sample collection and storage

Hematologic parameters

Before and after the completion of the 8-week exercise training program, blood samples (5 ml) were taken from the antecubital vein, with the participants in a seated position. Blood was centrifuged five times at 3000 rpm, and blood serum was separated. The blood samples were analyzed on site for concentrations of serum sodium (Na^+), potassium (K^+), iron (Fe^{++}), ionized calcium (iCa^{++}), chloride (Cl^-), magnesium (Mg^{++}), phosphorus (P), creatinine, and urea

nitrogen (BUN) using an i-STAT™ portable analyzer (Abbott, USA). An independent laboratory analysis was performed to determine the plasma.

Statistical analysis

In the analysis of the data, arithmetic mean, standard deviation (SD), statistically and frequency distribution techniques are used. Repeated measurements ANOVA was applied to determine whether there is a significant difference among pre-control group, post-control group, pre-training group and post-training group. A Bonferroni test

was performed for multiple comparisons and $p < 0.05$ was considered statistically significant.

Results

Table 1 shows that the significant relationship between exercise training and total urea level ($F=4.73$; $p < 0.005$). The repeated measurements ANOVA showed that BUN was meaningfully affected by exercise training ($F=10.98$; $p < 0.005$). Measurements ANOVA also showed that creatinine, like urea and BUN, was meaningfully affected by exercise training ($F=8.5$; $p < 0.005$).

Table 1. Measurements of urea, BUN and creatinine levels in pre and post training

Parameters			Mean	SD	F	p	Significant
Urea (mg/dl)	Control	Pre ^x	29.52	3.08	4.735	0.005*	t with x,y,z
		Post ^y	29.76	3.30			
	Training	Pre ^z	29.35	3.51			
		Post ^t	33.05	3.43			
BUN (mg/dl)	Control	Pre ^x	13.10	1.35	10.985	0.000*	t with x,y,z
		Post ^y	13.31	1.49			
	Training	Pre ^z	13.12	1.59			
		Post ^t	15.60	1.60			
Creatinine (mg/dl)	Control	Pre ^x	0.85	0.04	8.501	0.000*	t with x,y,z
		Post ^y	0.84	0.05			
	Training	Pre ^z	0.85	0.03			
		Post ^t	0.92	0.06			

Measurement values are shown as mean \pm SD (standard deviations). Prex, pre-control; Posty, post-control; Prez, pre-training; Postt, post-training; N = 17.

Table 2 shows that the significant relationship between exercise training and total calcium and phosphorus levels ($F=4.04$, $F=15.87$). The calcium values increased more in the post-training group than in the pre-training and control groups ($p < 0.05$). The chlorine, phosphorus, sodium and potassium values obtained were statistically significant ($F=5.81$, $F=15.87$, $F=6.27$, $F=5.63$). The chlorine, phosphorus, sodium and potassium values increased more in the post-training group than in the pre-training and control groups ($p < 0.005$). ANOVA showed that magnesium and iron increased significantly after exercise training. ($F=4.60$, $F=4.53$). This increase was proportionally higher in iron than magnesium. The magnesium and iron values increased more in the post-training group than in the pre-training and control groups ($p < 0.05$).

Discussion

The purpose of this study is to determine the effect of an 8-week basketball training on

the creatinine, urea, and electrolyte balance of basketball players. The urea concentration increased after the training^{6,19-24} and this increase was found to be statistically significant.^{6,19} However, this increase was not significant compared with that in the control group according to some sources²⁵⁻²⁷ which conclude that exercise does not stimulate urea production. However, some studies^{28,29} said that no changes are found in the plasma levels of urea. The present study indicated that urea increase is statistically significant. This result was similar to earlier reports by some studies.^{6,19} But it was unlikely to the reports of some authors.^{25,26}

The results of the present study show a statistically significant increase in serum creatinine. Omassoli et al.⁵ reported a statistically significant increase in plasma creatinine levels in 20 male volunteers performing 60-min standardized exercise at baseline and on four subsequent occasions during a 23-day.⁵ Although Décombaz et al.⁶

noted an increased plasma creatinine concentration after a 100-km run, the creatinine concentration was not statistically significant.⁶ Furthermore, Baxmann et al.² reported that individuals with moderate/intense physical activities presented statistically significant higher serum creatinine levels than those with a sedentary

lifestyle. Some studies^{2,5,6} indicate a statistically significant increased plasma creatinine concentration, but some studies^{19,25,26} did not confirm this result. Contrary to all these declarations, in this studies²⁰ in a 1600 km ultramarathon, some studies^{28,30} boxers reported no change in creatinine level.

Table 2. Measurements of electrolyte parameters in pre and post training

Parameters			Mean	SD	F	<i>p</i>	Significant
Calcium (mg/dl)	Control	Pre ^x	9.48	0.28	4.045	0.011*	t with x,y,z
		Post ^y	9.47	0.30			
	Training	Pre ^z	9.49	0.26			
		Post ^t	9.77	0.30			
Chlorine (mmol/l)	Control	Pre ^x	98.81	1.76	5.815	0.001*	t with x,y,z
		Post ^y	98.60	1.88			
	Training	Pre ^z	98.64	1.60			
		Post ^t	101.43	3.59			
Iron (µg·dL ⁻¹)	Control	Pre ^x	98.94	12.97	4.532	0.006*	t with x,y,z
		Post ^y	98.11	13.24			
	Training	Pre ^z	98.52	13.37			
		Post ^t	112.05	12.87			
Magnesium (mg/dl)	Control	Pre ^x	1.93	0.11	4.600	0.006*	t with x,y,z
		Post ^y	1.93	0.12			
	Training	Pre ^z	1.94	0.10			
		Post ^t	2.05	0.11			
Phosphorus (mg/dl)	Control	Pre ^x	3.37	0.21	15.872	0.000*	t with x,y,z
		Post ^y	3.40	0.22			
	Training	Pre ^z	3.39	0.23			
		Post ^t	3.88	0.32			
Potassium (mmol/l)	Control	Pre ^x	4.12	0.18	5.635	0.002*	t with x,y,z
		Post ^y	4.04	0.22			
	Training	Pre ^z	4.12	0.19			
		Post ^t	4.32	0.21			
Sodium (mmol/l)	Control	Pre ^x	138.46	2.44	6.279	0.001*	t with x,y,z
		Post ^y	137.98	1.50			
	Training	Pre ^z	138.52	1.25			
		Post ^t	140.31	1.21			

Measurement values are shown as mean ± SD (standard deviations). Prex, pre-control; Posty, post-control; Prez, pre-training; Postt, post-training; N = 17.

In the present study, Na⁺, K⁺, Cl⁻, iCa⁺⁺, Fe⁺⁺, Mg⁺⁺, and P levels were increased significantly by the exercise training. In this studies³¹ indicated that plasma mineral levels (calcium, chloride, copper, iron, magnesium, phosphorus, potassium, sodium, and zinc) were in normal levels and did not show a continuous decrease over a 20-day road race marathon period (500 km).³¹ In another study, Karakukcu et al.³² noted that the serum calcium level decreased ($p < 0.001$) and phosphorus increased ($p < 0.001$) after an acute exercise, but iron and magnesium levels did not differ ($p > 0.05$). Moreover, Fallon et al.²⁰ said that calcium and phosphate levels had significant increases, but serum

potassium level did not change after a 1600 km ultramarathon.

In another study³⁴ on mineral level reported that after volleyball matches, athletes also had a slight increase in sodium level and a decrease in potassium, magnesium, and calcium levels. Moreover, In another study²² mentioned a significant decrease in the magnesium level. Rose et al.³³ noted that marathon runners had a significant increase in sodium and potassium levels after running, but no significant change in the chloride or calcium levels occurred, and no change was found a significant decrease in the magnesium levels. The results of this study are described.

Some studies^{33,34} reported that sodium is similar and that the potassium level is consistent with.³³

The effects of the exercise were demonstrated by the analysis performed at the end of the 8-week exercise period, but if the weekly analysis were made, the rate of change could also be revealed.

Conclusion

The creatinine, urea and electrolyte balance of basketball players increased after the regular exercise training. The results of this study may contribute to the existing knowledge in this field.

Ethics Committee Approval

All procedures performed in this study comply with Helsinki declaration and corporate ethical standards. Before the study, our university's Non-Interventional Clinical Research Ethics Committee approval was obtained with the decision number 2017 / 7-1.

Informed Consent

Informed consent forms were obtained from all participants and their parents included in the study.

Authors' Contributions

We confirm that the authors whose names are included in this article (SK, AD, and YY.) Have made equal and significant contributions to the understanding of this study, have read and revised this article critically and approved the final draft. It is responsible for the content and publication of the manuscript.

Conflict of Interest

The authors (SK, AD, and YY.) do not have any interest-based relationship.

Financial Disclosure

This study has no financial source.

Statements

The results of this research have not been presented previously.

Peer-review

Externally refereed.

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